BAYOU COCODRIE TMDL FOR NUTRIENTS

SUBSEGMENT 060202

US EPA Region 6

Final

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. A TMDL has been developed for nutrients for Bayou Cocodrie.

Bayou Cocodrie, subsegment 060202 flows from the Cocodrie Diversion Canal to its intersection with Bayou Boeuf. Subsegment 060202 was listed on the October 28, 1999 Court Ordered §303(d) list as not fully supporting the water quality standards for propagation of fish and wildlife and was ranked as high priority for TMDL development. In the State of Louisiana Surface Water Quality Standards, the general criterion for nutrients states "The naturally occurring range of nitrogen-phosphorus ratios shall be maintained…. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters." In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated, "That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts." In this TMDL, the nutrient loading required to maintain dissolved oxygen standards will be the nutrient TMDL. The current applicable DO criterion for this subsegment is 5.0 mg/L year round.

EPA has identified nutrient ratios using twenty years of historical values in the State of Louisiana's database, and ranges of ratios found in scientific literature indicating nitrogen or phosphorus limitation. Literature generally indicates that where the nitrogen to phosphorus ratio is less than ten, a water body system is considered to be nitrogen limited. Review of historical State data for Bayou Cocodrie indicates that 9 out of 11 assessed sampling events displayed nitrogen limitation ratios and that phosphorus was not in excess (Appendix A). Since 82% of the sampling events confirmed nitrogen limiting conditions, it has been determined that a nitrogen TMDL for Bayou Cocodrie is warranted. A TMDL for phosphorus is not necessary because controls on nitrogen will maintain naturally occurring nitrogen-phosphorus ratios. Therefore, the nitrogen loading required to maintain the dissolved oxygen standard will constitute the nutrient TMDL.

This nutrient TMDL includes five point source dischargers, waste load allocations (WLAs), load allocations (LAs), and margins of safety (MOS). As presented in FTN Associates, Ltd. (2000), the summer season DO criterion of 5.0 mg/L can be maintained with a 100% reduction of all manmade nonpoint sources and implementation of the wasteload allocations (WLAs) for the point source dischargers as presented in Table 2 of this report. For the winter season, the DO criterion of 5.0 mg/L can be maintained with a 0% reduction of all manmade nonpoint sources and implementation of the WLAs for the point source dischargers as presented in Table 2.

1. Introduction

Bayou Cocodrie subsegment 060202 was listed on the October 28, 1999 Court Ordered §303(d) list as not fully supporting the water quality standard for the propagation of fish and wildlife. A TMDL for nutrients was developed in accordance with the requirements of Section 303 of the federal Clean Water Act. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources for the pollutant of concern, and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

2. Study Area Description

2.1 Bayou Cocodrie, Subsegment 060202

Bayou Cocodrie is located within segment 0602 in south central Louisiana. Bayou Cocodrie, subsegment 060202 flows from the Cocodrie Diversion Canal to its intersection with Bayou Boeuf. The Red River is now leveed, eliminating the potential for a natural flow of water from the River into any of the streams in Segment 0602.

Land use is predominantly forestry and agriculture with the Alexandria urban area located to the north. Suburban communities have developed in the agricultural lands immediately south and west of Alexandria. The major land uses are listed in Table 1. See FTN Associates, Ltd. (2000) for additional discussion of the study area.

Table 1. Land Use (acres) in Segment 0602: Vermilion-Teche Basin

SEGMENT	AGRICULTURE	URBAN	WETLAND	FOREST
0602	6,464 (40.4%)	589 (3.7%)	2,638 (16.5%)	5,499 (34.4%)

2.2 Water Quality Standards

The designated uses for Bayou Cocodrie include the propagation of fish and wildlife. In the State of Louisiana Surface Water Quality Standards, the general criterion for nutrients states,

> "The naturally occurring range of nitrogen-phosphorus ratios shall be maintained….Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters."

In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated,

> "That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts."

DO serves as the indicator for the water quality criteria and for assessment of use support. In this TMDL, the nutrient loading required to maintain the dissolved oxygen standard is the nutrient TMDL.

EPA has identified nutrient ratios using historical values in the State of Louisiana's database, and ranges of ratios found in scientific literature indicating nitrogen or phosphorus limitation. Based upon the literature, nitrogen to phosphorus ratios of less than ten are generally indicative of a nitrogen limited water body system (Wetzel 1975, Day 1989, Allan 1995). The one-year average for nitrogen to phosphorus ratio (June 1998 through December 1998) in Bayou Cocodrie is 6.92 (Appendix A). Review of historical State data for Bayou Cocodrie also indicates that 9 out of 11 assessed sampling events displayed nitrogen limitation ratios and that phosphorus was not in excess (Appendix A). Since 82% of the sampling events confirmed nitrogen limiting conditions, it is determined that nitrogen TMDLs for Bayou Cocodrie are warranted. A TMDL for phosphorus is not necessary because controls on nitrogen will maintain naturally occurring nitrogen-phosphorus ratios. Therefore, the nitrogen loading required to maintain the dissolved oxygen standard will constitute the nutrient TMDL.

The applicable dissolved oxygen criterion is as follows:

Season	Temperature (^{o}C)	DO(mg/L)
Year Round	32	5.0

2.3 Identification of Sources

No sources were identified in the *1998 Louisiana Water Quality Inventory* as affecting the water quality of Bayou Cocodrie (LDEQ, 1998). Suspected sources identified in the State's 1993 Nonpoint Source §319 Report include irrigated/non-irrigated crop production, pasture land, and urban runoff. (LDEQ, 1993)

2.3.1 Point Sources

There are five permitted facilities with known flow information discharging sanitary wastewater into Bayou Cocodrie and its tributaries (see Table 2). Nutrient contribution from the point source dischargers will be controlled through NPDES permit limits for NH_3-N, which is representative of total nitrogen.

Table 2. Point Source Wasteload Allocations

Dischargers to Bayou Cocodrie											
Facility	Permit #	Receiving Water	Discharge Flow MGD	Summer CBOD5/ NH3-N/ Org-N mg/l	Winter CBOD5/ NH3-N/ Org-N mg/l	Summer CBOD5 WLA lbs/day	Summer NH3-N WLA lbs/day	Summer Org-N WLA lbs/day	Winter CBOD5 WLA lbs/day	Winter NH3-N WLA lbs/day	Winter Org-N WLA lbs/day
Village of Forest Hill	LAG570142	Hurricane Ck, then to Cocodrie Lk	0.074	10/10/20	10/10/20	6.17	6.17	12.34	6.17	6.17	12.34
City of Glenmora	LA0054925	Little Spring Ck, then to Cocodrie Lk	0.228	10/2/4	10/10/20	3.80	19.01	7.61	19.01	19.01	38.03
Cleco's Evangeline Power Station	LA0002879	Bayou Cocodrie	118	1.17/0.09/0.23*	1.17/0.09/0.23*	1151.42	88.57	226.35	1151.42	88.57	226.35
Chicot State Park WWTP	LAG540413	Lake Chicot	0.012	10/10/5	30/15/7.5	1.0	1.00	0.50	3.00	1.50	0.75
Plaquemines Alligator Farm	LA0109011	Choctaw Bayou, then to Lake Chicot	0.080	10/5/2.5	10/25/12.5	6.67	3.34	1.67	6.67	16.68	8.34
		TOTAL				1169.06	118.09	248.47	1186.27	131.93	285.81
		TOTAL (NH3-N * 4.3=UNBOD)					507.8			567.29	
		TOTAL (Org-N * 4.3=UNBOD)						1068.42			1229.0
		TOTAL (CBOD5 * 2.3=UCBOD)				2688.84			2728.42		

Note: NH3-N represents total nitrogen; WLA (lb/day) = Flow (MGD) * concentration (mg/L) * 8.34.
*concentrations found on page 6 of Appendix M of FTN Associates, Ltd. (2000) (CBOD5 = BOD / 2.3)

2.3.2 Nonpoint Sources

The predominant land uses along Bayou Cocodrie are agriculture and forestry, both of which can contribute to nutrient loads through runoff. However, it is presently unknown to what relative extent these sources contribute to nutrient loads.

3. TMDL Load Calculations

LDEQ submitted a DO model for Bayou Cocodrie subsegment 060202 in September 2000 (FTN Associates, Ltd. 2000). The model was reviewed and approved by EPA. This model was used to address nutrient listing for this segment. Tables 2.3 and 4.3 in the DO TMDL modeling report (FTN Associates, Ltd. 2000) included cumulative WLAs, LAs, and MOS for five point source dischargers. The individual discharger WLAs were recalculated based on $CBOD_5$, NH_3-N, and organic-N concentrations as listed in FTN's 2000 summer and winter TMDL calculations for Bayou Cocodrie (see Table 6.1, as well as page 6 of Appendix M in FTN Associates, Ltd (2000)). Tables 2 and 3 present the WLAs, LAs, and MOS for this nutrient TMDL.

3.1 Loading Capacity and TMDL Formulation

According to FTN Associates, Ltd. (2000), input data for the calibration model were developed from the LDEQ Reference Stream Study, data collected during the 1999 intensive survey, data collected by LDEQ and USGS at several ambient monitoring stations in the watershed, DMRs and permits for each of the point source dischargers, USGS drainage area and low flow publications, concurrent modeling studies being conducted by LDEQ in the area, and data garnered from several previous LDEQ studies on non-point source loadings. A satisfactory calibration was achieved for most of the system. In those cases where the calibration was not as accurate (primarily due to extremely limited data), the difference was in the conservative direction. For the projection models, data was taken from the current discharge permits and ambient temperature records.

Modeling was limited to low flow scenarios for both the calibration and the projections since the constituent of concern was dissolved oxygen and the available data was limited to low flow conditions. The model used was QUAL-TX, a modified version of the QUAL-II. QUAL-TX was selected since it offers the ability to model branched systems and has been used successfully in Louisiana in the past. See FTN Associates, Ltd. (2000) for additional discussion of the modeling system used in this TMDL.

3.2 Load Allocations

Seasonal load allocations are presented in Table 3. See FTN Associates, Ltd. (2000) for a detailed discussion of load allocations. The load allocation in Table 3 is calculated using the sum of natural nonpoint source LAs and manmade nonpoint source LAs (See Tables 4.2, 4.3 and 4.4 in FTN Associates, Ltd. (2000)).

As presented in FTN Associates, Ltd. (2000), the summer season DO criterion of 5.0 mg/L can be maintained with a 100% reduction of all manmade nonpoint sources and implementation of

the wasteload allocations (WLAs) for the point source dischargers as presented in Table 2 of this report. For the winter season, the DO criterion of 5.0 mg/L can be maintained with a 0% reduction of all manmade nonpoint sources and implementation of the WLAs for the point source dischargers as presented in Table 2.

Table 3 Total Maximum Daily Loads

ALLOCATION	SUMMER (June – August) lbs/day UBOD=UCBOD+UNBOD	WINTER (September – May) lbs/day UBOD=UCBOD+UNBOD
Point Source WLA	4265	4525
Margin of Safety	3905	6583
Load Allocation	149729	152386
TMDL	157899	163494

3.3 Wasteload Allocations

Seasonal wasteload allocations for individual point source dischargers are presented in Table 2. The total cumulative WLAs for summer and winter are presented in Table 3.

3.4 Seasonal Variation

Critical conditions for dissolved oxygen in Louisiana have been determined to be when there is negligible nonpoint run-off and low stream flow combined with high stream temperature. In addition, the models account for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the stream during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons. Additionally, this TMDL looked at the winter and summer seasons by varying temperature.

3.5 Margin of Safety

The margin of safety (MOS) presented in Table 3 was calculated as the sum of point source reserve MOS and manmade nonpoint source reserve MOS (FTN Associates, Ltd. 2000). The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. According to FTN Associates, Ltd. (2000), the highest temperatures occur in July-August, the lowest stream flows occur in October-November, and the maximum point source discharge occurs following a significant rainfall, i.e. high-flow conditions. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implied MOS that has not been quantified. Over and above this implicit MOS, LDEQ regularly uses an explicit MOS of 20% for point and up to 10% for nonpoint loads, as was done in this TMDL.

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) (LDEQ,1998) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been established by the time the first priority basins are monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

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Day, J.W. Jr., et al. 1989. *Estuarine Ecology.* John Wiley and Sons, New York.

FTN Associates, Ltd. 2000. Bayou Cocodrie Watershed TMDL For Dissolved Oxygen Including WLAS For Five Point Source Discharges, Subsegments 060101, 060102, 060201, 060202, and 060203, Surveyed September 1999 (Revised). Little Rock, AR.

LDEQ, 1993**.** *State of Louisiana Water Quality Management Plan, Volume 6, Part A: Nonpoint Source Pollution Assessment Report.* Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

LDEQ, 1998. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory.* Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge,La.

LDEQ Data Web Site. www.deq.state.la.us/surveillance/wqdata/wqnsites.stm

Wetzel, R. G. 1975. *Limnology.* W.B. Saunders Co., New York, NY.

APPENDIX A. Nutrient data.

All nutrient data collected at Bayou Cocodrie over the specified period of record can be found on the Louisiana Department of Environmental Quality's web site at:

http://www.deq.state.la.us/surveillance/wqdata/0664wqnn.txt.

060202 Bayou Cocodrie at Diversion Canal

Date	NO_2+NO_3 mg/L	TKN mg/L	TP mg/L	TOC mg/L	TN* mg/L	N:P**	Avg N:P	Time	Depth m
12/9/98	0.08	1.10	0.16	14.4	1.18	7.38	6.92	1120	1.0
11/24/98	0.09	0.78	0.18	14.3	0.87	4.83		1115	1.0
11/10/98	0.10	0.99	0.15	14.8	1.09	7.27		950	1.0
10/28/98	0.10	1.14	0.18	15.9	1.24	6.89		1240	1.0
10/14/98	0.15	1.34	0.11	16.7	1.49	13.55		1120	1.0
9/23/98	0.08	0.57	0.19		0.65	3.42		1200	1.0
9/9/98	0.07	1.39	0.36		1.46	4.06		1140	1.0
8/26/98	0.07	0.68	0.18		0.75	4.17		1200	1.0
8/11/98	0.20	0.38	0.08		0.58	7.25		1223	1.0
7/28/98								1215	1.0
7/14/98	0.51	1.20	0.28		1.71	6.11		1150	1.0
6/23/98	0.23	1.67	0.17		1.90	11.18		1215	1.0

*Total Nitrogen (TN) = (NO_2+NO_3) + TKN (Total Kjeldahl Nitrogen)
** N:P = TN:TP